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Coherence of Sound using Navy Sonars and Theoretical Developments

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LONG-TERM GOALS

The long term goal is to understand how and where the ocean affects the propagation of sound. The theory of rays is the traditional approach for quantifying where sound is affected. However, it has recently been determined that ray theory is very inaccurate at low and moderate frequencies.

OBJECTIVES

The primary objective is to use modern theories of wave propagation to quantify where the ocean affects the propagation of sound. The secondary objective is to understand how accurately models can be used to predict the coherence time of low frequency sounds in the deep ocean based on the fluctuations of internal waves.

APPROACH

Godin's OWWE parabolic approximation obeys reciprocity exactly (Godin, 1999). Theories that estimate where the ocean affects the propagation of sound between points require a model that obeys reciprocity. Acoustic solutions derived from OWWE will be applied to the Differential Regions of Influence (DRI) theory (Spiesberger, 2005, 2006) to quantify the regions in the ocean that affect the propagation of sound. At high frequencies, these regions look like rays, but not at lower frequencies, even below a few thousands of Hertz. The DRI theory appears to be exact for all frequencies and bandwidths.

WORK COMPLETED

This program is just getting started. At this early time, software was written to quantify the accuracy, computational efficiency, and degree of reciprocity of three parabolic approximations, RAM, Tappert's c0-insensitive, and OWWE.

RESULTS

No results are available because the program recently started.

IMPACT/APPLICATIONS

Because the theory of rays is used by the fleet every day for sonar operations, it is possible that the modern theories that replace the ray-picture will someday be used routinely for fleet operations. This is particularly so since the theory of rays does not appear to be valid at low and moderate frequencies for many applications (Spiesberger, 2006).

RELATED PROJECTS

Dr. Dmitry Mikhin of Acacia Research Pty. Ltd. is collaborating with this investigation.

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